

CURRICULUM

Q
181.5
A319
1962

ALTA
500
1962
Gr9

CURRGDHT

CURR

C. 2
196

Grade IX

Curriculum Guide

for

SCIENCE

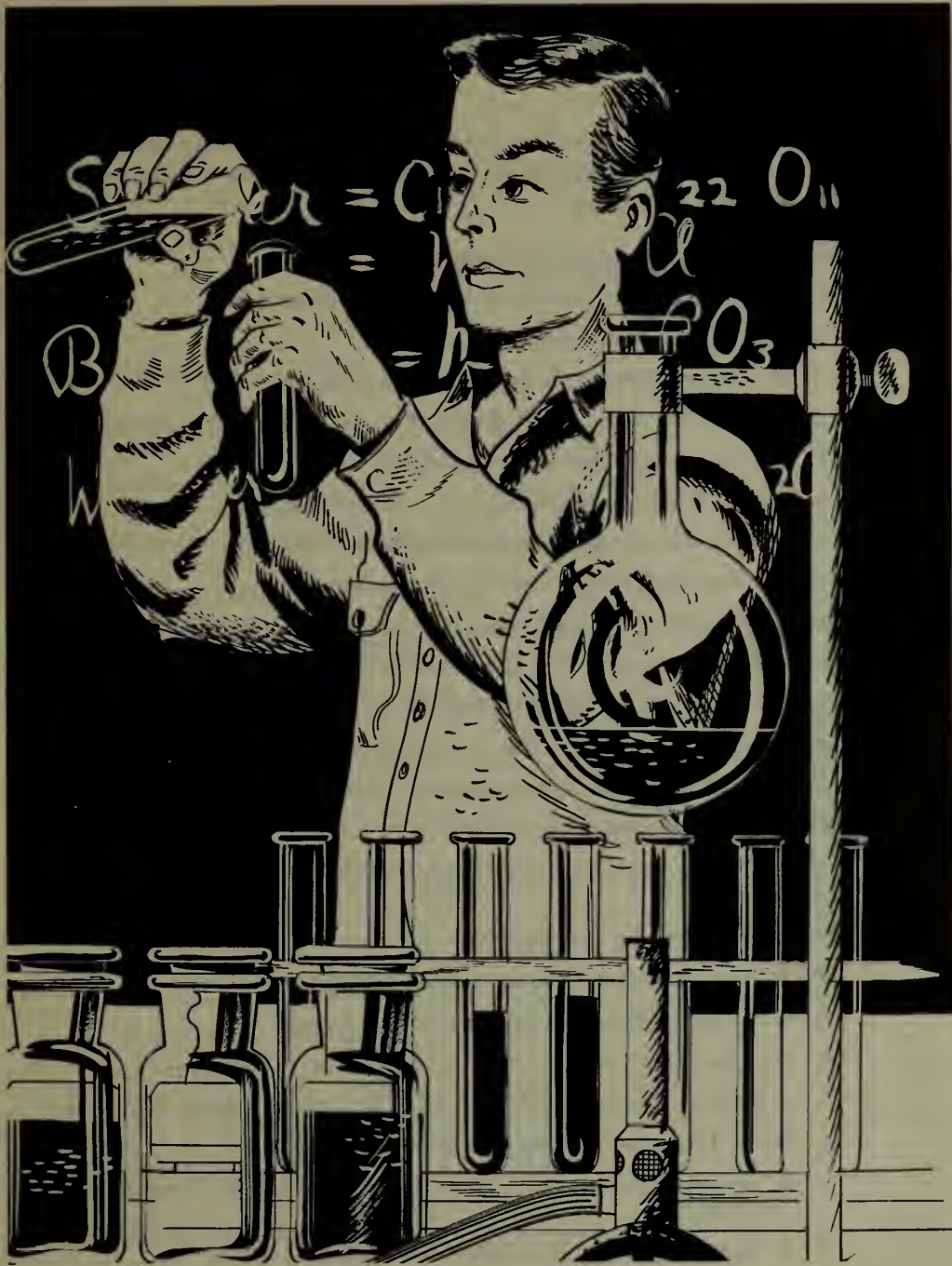
**GOVERNMENT OF THE PROVINCE OF ALBERTA
DEPARTMENT OF EDUCATION**

1962

D



500
7902
Cr 7



Acknowledgement

The Department of Education acknowledges with appreciation the contributions of the following committee members to the preparation of this curriculum guide for Junior High School Science.

Junior High School Curriculum Committee

- Morrison L. Watts, Director of Curriculum (Chairman)*
- A. A. Aldridge, Supervisor of Guidance*
- A. M. Arbeau, Edmonton Separate School Board*
- Dr. T. G. Finn, Associate Professor, Faculty of Education, Calgary*
- S. W. Hooper, Superintendent of Schools*
- Miss A. B. MacFarlane, Supervisor of Home Economics*
- L. J. McKenzie, Coordinator of Elementary Education*
- O. Massing, High School Curriculum Assistant*
- H. E. Panabaker, Assistant Superintendent, Calgary Public School Board*
- Mrs. W. B. Parsons, ASTA Representative, Red Deer*
- R. P. Plaxton, ATA Representative, Calgary*
- R. E. Shaul, Supervisor, Edmonton Public School Board*
- Mrs. J. Shedden, HSA Representative, Edmonton*
- J. F. Swan, Superintendent of Schools*
- N. M. Purvis, Associate Director of Curriculum (Secretary)*

Junior High School Science Subcommittee

- H. A. Pike, Superintendent of Schools (Chairman)*
- A. M. Arbeau, Edmonton Separate School Board*
- C. Hampson, Professor, Faculty of Education, Edmonton*
- N. A. M. Knowles, Principal, Riverdale Elementary School, Edmonton*
- S. Norris, Professor, Faculty of Education, Calgary*
- V. R. Nyberg, Coordinator of Tests and Measurements, Department of Education*
- N. M. Purvis, Associate Director of Curriculum*
- R. A. Roberts, Principal, Hillhurst Elementary-Junior High School, Calgary*
- H. R. Ross, Superintendent of Schools*
- R. E. Shaul, Supervisor of Junior High Schools, Edmonton Public School Board*

TABLE OF CONTENTS

	Page
Acknowledgement	2
Preface	4
Primary Consideration	5
Making Science Teaching More Effective	6
Perspective and Grade Grids	7
Experiments and Demonstrations	16
Enrichment	17
A Reminder Regarding Equipment	18
Introduction	19
Course Outlines	
Unit I Measurement	21
Unit II Light	25
Unit III Combustion and Fuels	31
Unit IV Heat and Temperature	41
Unit V Machines	55
Unit VI Energy and Transportation	61
Enrichment Reading List	67
Filmstrip List and Periodicals	68
List of Apparatus etc., for Grade IX Science Laboratory	69

PREFACE

The design of the Grade IX edition, follows the pattern set in the Grades VII and VIII guide. In the unit outlines the policy of strengthening the course content has been carried forward and the emphasis on experimentation and demonstration has been continued. The practice of listing aids and references in detail has been retained.

From the outset it was realized that a re-shuffle of the old material was not enough but that sweeping changes were required. In particular, there was a need for the strengthening of content and for a change in the general approach to the teaching of science. As a result, the new outline contains much material for each grade formerly found in a higher grade. Furthermore there is a new emphasis on critical thinking on the part of the pupils and a demand for more experimentation and demonstration conducted by pupils as well as by teachers.

Preliminary notes and discussions have been cut to the bare essentials in this guide. However, in order to establish and maintain a reasonably high minimum standard of teaching the instructions regarding content, suggested treatment and sources of information are given in detail.

This science outline, the 1959 edition, deals with the teaching of science in Grades VII and VIII. The course, largely in its present form, was used experimentally in nine schools in the 1958-59 school year. In September of 1960 a new Grade IX course outline, also an interim edition, will be introduced and in September, 1962, a final draft, consisting of the outline for Grades VII, VIII and IX, will be authorized.

Primary Considerations

Science has two meanings: first, it is a body of organized knowledge; secondly, science is a method of solving problems.

There are many sciences or organized bodies of knowledge such as physics, chemistry, botany, zoology, geology and mathematics. Each has its own set of facts and its own technical vocabulary. All have the scientific method in common.

Why Teach Science?

Science teaching should begin with the consideration of facts. However, when this has been done the task has just begun. The facts must be used to lead the pupils to an understanding of scientific principles and to the development of generalizations.

Along with this there should be the development of: a scientific attitude, skills, habits, the ability to solve problems scientifically and an appreciation of the contribution of scientists.

What are the Scientific Methods of Solving Problems?

Scientific methods are organized plans for solving a problem. Here are the essential steps of one method:

- (1) The scientist first defines the problem. He usually lists what he knows about the problem and then isolates the unknown factor or factors in the light of all the known facts.
- (2) The scientist next formulates a hypothesis.
- (3) The next step is to test the hypothesis by experiment. If the experimentation fails to verify the hypothesis it is discarded and a new one is set up. The process is then repeated until the hypothesis selected seems to fit. The hypothesis is usually accepted as valid when a number of experiments support it.
- (4) The final step consists of checking the tentative conclusion with the results obtained by other scientists.

What is the Scientific Attitude?

These characteristics are commonly associated with one who has a scientific attitude:

- (a) He has an INQUIRING MIND.
- (b) He is CAREFUL and ACCURATE in his work.
- (c) He is IMPERSONAL in his attitude towards a problem; he is unswayed by superstition and prejudice.
- (d) He is OPEN-MINDED. His hypotheses are discarded or altered if they do not agree with new facts.
- (e) He is CRITICAL. He continually asks himself questions such as "Can I rely on these facts? What is their source? Am I equally critical of my own thinking?"
- (f) He is SKEPTICAL although he respects the work of experts.

Making Science Teaching More Effective

Science teaching can be made more effective by applying the following principles:

1. The teaching should begin where previous experience and learning have left off and should take into account the needs of the pupils.
2. The teacher must establish definite goals within each unit. Interest may be aroused by discussion, questions, visual material, the posing of problems and relating the work to the students' own experiences.
3. Teaching is most effective when the pupils are encouraged to do their own thinking. Scientific principles cannot be taught as facts to be memorized, but must be a product of the pupils' own mental processes. Pupil experiences should be centered about specific generalizations which will be arrived at largely by careful observation and conclusion on the part of the pupils themselves.
4. The more the facts and laws learned are applied, the better they are understood and the more likely they are to be retained. (This principle of use is an extension of number three.) The frequent consideration of problems and exercises involving the generalizations previously learned reinforce understandings.
5. A good science teacher realizes the importance of reading and assumes a two-fold responsibility in this regard:
 - (a) Abundant free reading in the field of science should be made available. This is in addition to the regular secondary reference material.
 - (b) In order to read with understanding a pupil must have an adequate knowledge of the vocabulary of science. Every science teacher should make certain that attention is given to teaching this vocabulary.
6. Science teaching is more stimulating and challenging when pupils are encouraged to work at first hand with the materials of science. Experiments and demonstrations are an essential part of any science program.

Perspective

To be more effective, a teacher of science must know how the work at hand fits into the total picture. Needless repetition of work covered previously by a class will be avoided by a teacher who is familiar with what has been taught in the preceding grades. Also, if a teacher knows what is to be offered to the class in succeeding grades, problems resulting from carrying a unit of study too far can be avoided.

Teachers should familiarize themselves with the science curriculum outline for each of the elementary, junior and senior high schools.

To help teachers obtain a proper overall picture of the science program summaries or “grids” for elementary, junior and senior high schools are included in this course outline. Staff meetings or consultations to familiarize teachers with the science programs at all levels are strongly recommended. It has been established that if these meetings are held early in the fall they will be of maximum value.

The term “Suggested Treatment”, that heads one of the four columns in the outline of each unit, needs clarification. The purpose of the information given under the heading is to acquaint teachers with *one* method of presentation recommended by experienced teachers. The presentation is primarily intended for beginning teachers and for others whose area of specialization is other than science. It must be emphasized that the treatment is *suggestive*, but *not prescriptive*.

LIVING THINGS

THE EARTH AND

PREPARED BY THE VACCINATION

ELEMENTARY SCHOOL SCIENCE

GRADE IV	GRADE V	GRADE VI
How Living Things are Grouped Living and non-living. Plants and animals. Seven groups of animals. Two groups of plants. How Some Plants and Animals Make us Sick Tiny plants and animals called germs. Some bacteria cause disease, others are helpful. Bacteria are everywhere and multiply very fast. Why Do All Living Things Need Air and Water? Animals and plants need oxygen to breathe. Plants use carbon dioxide to make food. Plants need water to dissolve food. Animals need water to make digestive juices and the liquid part of the blood. Conservation—Care of trees. Feeding birds in winter.	Where Do New Plants and Animals Come From and How Do They Grow? Mammals, birds, amphibians, etc. Plants grow from seeds, roots, stems, leaves, grafting, spores. Where Plants Grow—Enrichment suggestion. Conservation—Living Things. Forests.	Interdependence of Living Things Animals and animals. Plants and plants. Animals and plants. What is the History of Living Things? Earth long ago. Fossils. Plants and animals have changed. Importance of ability to adapt. Fish Life—Enrichment. Conservation—Wild Life. Soil.
The Earth—Its shape, spins on its axis, travels 'round sun. Has a blanket of air which is a mixture of gases, pressing on all things. Man uses this pressure. Has soil on its surface essential to plants and animals. Contains valuable rocks and minerals. Conservation Using Materials Wisely.	What is the Universe Like? Solar system, comets, eclipses, beyond the solar system, birth of our earth. Changing the earth's surface.	Weather and How We Forecast It Rain, Hail, Snow, Sleet, Wind. The Milky Way and Beyond. Our Earth—A huge Magnet. The Earth's Airways and Beyond. Why The Seasons Change. Animals and Seasonal Changes.
Static Electricity Charging objects, behavior of charged objects, lightning, thunder. Current Electricity Uses, current coming into homes, safety of using dry cells in experiments, conductors, insulators. Our Body Is a Machine Muscles move, bones and joints are levers, food provides energy. Machines Help Man by Using Air Pressure Electrical energy and energy from coal, petroleum, natural gas. Conservation Using Materials Wisely.	Electricity—Production and Control. Current electricity, frictional. How current flows. Why wires are covered. Production of heat, light, magnets, telegraph keys, electric bells. Effect of Heat and Cold on Materials Heat travels, effect of heat and cold on gases, liquids, solids. Heat and cold cause changes in gases, liquids and solids. What Things are made of Elements, compounds, molecules, chemical changes, facts about elements. How We Control Fires Materials to make fire, what happens when things burn, conserving fuels, preventing fires, putting out fires. Conservation—Prevention of Fire. Conservation of Heat.	How Machines Can Fly Man's observation of birds, insects, animals, seeds. Gliders, airplanes with motors, jet airplanes, safety in air travel. How Machines Help Us To Do Work Work, levers, inclined planes, pulleys, wheel and axle, making machines work better, safety around machines. What is Sound and How Does it Travel? Making sounds, how they travel, different sounds, controlling sounds, musical instruments, how our ears work. What We Know About Light Where it comes from, how it travels, how we see, mirror, lenses, how our eyes work, color in light, proper lighting. Conservation—Care of eyes and ears.

Junior High School Science

Grade VII Content

Introduction—Making a Good Beginning

I. Plants, Fall Activities

Importance of plants
Parts of a plant
New varieties of plants
Wheat
Gardening
Flowers for the home and schoolroom
Common Alberta flowers
Plants and clothing

II. Earth's Crust

Age of the earth
Structure of the earth
Classification of rocks
The changing earth
Evidence of pre-historic life
Kinds of fossils
Geological eras, periods and epochs
Four important geological eras

III. Soil and Erosion

Importance of soil
Composition of soil
Soil forming agencies
Water and air in the soil
Soil fertility
Soil erosion

IV. Water

Importance of water
The water cycle
Hard and soft water
Water purification
Conservation of water

V. Plants, Spring Activities

Trees and conservation
Seeds and germination
Gardening
Improvement of grounds
Plant enemies

Grade VIII Content

Introduction—Making a Good Beginning

I. Animals

Comparing plants and animals
Invertebrates
Vertebrates
Necessity for conserving wildlife
Methods of conserving wildlife
Young people and conservation

II. Magnetism and Electricity

Magnets
Electricity at rest and in motion
Static electricity
Magnetism and electricity
Uses of electro magnets
Producing and Using Electricity
Generators and motors
Power plants
Electricity in the home
Heat and light from electricity
Communication

III. The Solar System

Early ideas about the universe
Present ideas about the solar system
The sun
The earth
The moon
The planets
Astronomy and the stars
Smaller objects in the solar system
Stars of many kinds
Artificial satellites and looking to the future

IV. Weather

Weather and climate
Air pressure and weather
Winds and weather
Water vapor and weather
Clouds and weather
Weather forecasting

V. Domestic Animals

Using and improving domestic animals
Cattle—Dairy and beef cattle
Livestock for power, fibre and food
Horses, sheep, swine, poultry and honeybees

6

Grade IX Content

- | | |
|--|--|
| <p>I. Introduction—1 week
What is Science?</p> <p>II. Measurement—1 week
British—Metric System</p> <p>III. Light—4 weeks
Illumination
Effects of Light
Optical Instruments
What is Color</p> <p>IV. Combustion and Fuels—7 weeks
Oxygen and Hydrogen
Fires and Their Control
Coal
Oil and Natural Gas
Carbon Dioxide</p> | <p>V. Heat and Temperature—8 weeks
Effects of Heat
Transmission of Heat

What is Heat
Evaporation of Liquids</p> <p>VI. Machines—9 weeks
Review measurement
Force, work and power
Simple machines
Levers
Energy
Gases and the kinetic theory
Properties of liquids
Pumps and buoyancy</p> <p>VII. Transportation—5 weeks
Steam Engines
Internal Combustion Engines
Aircraft
Jets, Rockets and Missiles</p> |
|--|--|

2
2
13
8
19
5
3

35 week

2
35
+ 5
17

Senior High School Science

SCIENCE 10

The prescribed text for Grade X is INTRODUCTORY CHEMISTRY AND PHYSICS by Pickard and Radomsky.

text.

The course outline sets out a logical arrangement of the concepts and must be followed (Section I, Section II, then Section III) because of the large number of students who transfer during the year. For large schools where the number of classes make it desirable to offer both the chemistry and physics simultaneously to different classes, transfer presents no problem.

More detailed information is included in the **Early Warning Announcement** distributed by the Department of Education in June, 1960.

The course consists of three sections.

Section I Introduction To Science

Unit 1 Short History of Science

Chapter 1. Our Debt to the Past

Unit 2 Matter

Chapter 2. Matter—Its Classification

Chapter 3. Matter—Its Composition

Chapter 4. Matter—Its Structure

Section II Introduction To Chemistry

Unit 3 Language Of Chemistry

Chapter 5. Symbols and Formulae,
The Shorthand of
Chemistry

Chapter 6. Equations—Short Stories of
Reactions

Unit 4 Four Important Substances

Chapter 7. Oxygen—Our Most
Abundant Element

Chapter 8. Hydrochloric Acid—
A Typical Acid

Chapter 9. Sodium Hydroxide—
A Typical Base

Chapter 10. Sodium Chloride—
A Typical Salt

Section III Introduction To Physics

Unit 5 Mechanic of Fluids

Note: Most of this unit is optional, that is, Chapter 11 to 15. However, in Chapter 13 the section on the Expansion of Gases (Boyle's Law) and also Experiment 13 in Chapter 15 are required for study. It is suggested that this material be covered in conjunction with Chapter 19.

Unit 6 Heat

Chapter 16. Heat and Temperature

Chapter 17. Expansion of Solids

Chapter 18. Expansion of Liquids

Chapter 19. Expansion of Gases

Chapter 20. Specific Heat and Thermal
Capacity

Chapter 21. Latent Heat

Chapter 22. Experiments on Heat

Unit 7 Sound

Chapter 23. Production, Propagation
and Velocity of Sound

Chapter 24. Transmission of Sound

Chapter 25. Distinguishing Features
of Sound

Chapter 26. Resonance: Sympathetic
Vibration

Chapter 27. Laws of Stretched Strings

Chapter 28. Experiments on Sound

SCIENCE 20

The following outline is intended for all schools during 1962-63. The sequence of Physics then Chemistry is to be followed to avoid difficulty of student transfer during the school year.

The texts for the Physics-Chemistry (Science 20) are as follows:

1. PHYSICS FOR SECONDARY SCHOOLS,
Alberta Edition:
Eubank, Ramsay, Rickard
2. CHEMISTRY FOR SECONDARY SCHOOLS,
Advanced Edition:
Croal, et al

All students should be requested to buy these two texts.

Laboratory experience should be provided. The teacher's reference for this work is **EXPERIMENTS IN LABORATORY CHEMISTRY**, Couke, Croal, Loudon (Copp Clarke).

The course consists of a physics section and a chemistry section as outlined below:

A. Physics Section

1. Mechanics

Suggested time—2 months

- Chapters
1. Introduction
 2. Measurement
 3. Density and Specific Gravity
 4. Buoyancy
 5. Force, Work and Power
 6. Experiments on Mechanics

2. Light

Suggested time—2 months

- Chapters
7. Nature and Propagation of Light
 8. Photometry
 9. Reflection of Light—Mirror
 10. Refraction of Light—Lenses
 11. Color
 12. Optical Instruments (Optional)
 13. Experiments on Light
 14. Modern Developments in Physics (Optional)

Experimental work is to be considered an integral part of the course. Students should spend at least one day a week in the laboratory. All problems at the end of each chapter should be done by the students.

B. Chemistry

Suggested time—4 months.

Unit 1

Review of Science 10, Chemistry Section—Much of this review of Science 10 will be incidental and used throughout the course to introduce new work. However, as a general introduction certain terms should be discussed and definitions established. These terms should include: element, compound, atom, molecule, atomic and molecular weights. The four main types of chemical reactions should be reviewed as well as the method of writing and balancing equations.

Unit 2

Naming Compounds—In addition to the study of the system used in naming compounds this should include practice in the writing of formulae. Pages 139 - 146.

Percentage composition of a compound, pages 119 - 123.

Unit 3—Mathematics of Chemistry

Review percentage composition.

Review of Weight to Weight problems, pages 147, 148. Questions page 151.

The Gas Laws (Review of Science 10 Physics) pages 89 - 99.

Gay-Lussac's Law of Volumes and Gram Molecular Relationships of Weight to Volume in Gases, pages 105 - 106, Questions page 152.

Calculations involving the finding of simple and true formulae from percentage composition of compound, pages 119 - 123.

Unit 4—Ionization

Study of the terms referring to water and solution, pages 56 - 80.

Study of ionization, pages 153 - 163.

- Include: (1) Electrolysis of Water. Acids, Bases, Salts, Neutralization (review plus ionization characteristics).
(2) Hydrolysis

Unit 5 The Periodic Classification of the Elements

The Periodic Table, pages 234 - 239. This study should include the relationship between the atomic structure of the elements and the table. Review pages 133 - 138 and the table found in the front-end paper.

Application of the Periodic Table as seen in two families of elements.

(a) The Halogens

1. Atomic structure—see front-end paper.
2. Comparison of properties of chlorine (page 221), bromine (page 228) and iodine (page 230).

(b) The Alkali Family

1. Atomic structure—see front-end paper.
2. Properties, pages 240 - 241.

Unit 6—(Optional) Two Gases

Hydrogen, pages 42 - 55.

Nitrogen and Atmosphere, pages 33 - 41.

CHEMISTRY 30

1. **Authorized Text:** *Chemistry For Secondary Schools*, Advanced Edition: Croal et al.

2. **Course Content:**

The course consists of Chapters 10 - 15 (review) and Chapters 16 - 33 (new material). Owing to the length of the course, Chapters 24, 25 and 26 are to be considered as material for reading and additional study if time permits. These chapters are NOT included in the work that will be covered in the Departmental Examinations.

Chapters 10 - 15 have been included in order to provide for the necessary review of the fundamental mathematics of chemistry. It is suggested that no longer than four (4) weeks be used for this review.

3. **Demonstrations and Experiments:**

The revised laboratory manual consists of twenty laboratory exercises, eleven of which include demonstration material. Students will be expected to perform no fewer than fourteen laboratory exercises, including the obligatory exercises. 1, 2, 3, 4, 7, 13, 17, 18, 20, 23, 24 (1958 *Laboratory Exercises in Chemistry* 30). Additional experimental material may be found in *Experiments in Laboratory Chemistry* referred to in Science 20.

4. **Equipment:**

A list of equipment, needed for the prescribed experiments, is contained in *Laboratory Exercises*.

PHYSICS 30

Information on Course Content and Laboratory Exercises.

1. **Authorized Text:** *Elementary Physics*, Littler

2. **Course Content:**

- (a) The content selected from the text consists of materials on three topics: Mechanics, Heat and Electricity.

- (b) The following portions of the text are used:

1. **Mechanics:** Chapters 1 - 9
Velocity
Acceleration, Falling Bodies
Newton's Second Law of Motion
Newton's Third Law of Motion
Work Energy and Power
Machines and Their Efficiency
Composition and Resolution of Forces
Movement of a Force: Center of Gravity
Friction

2. **Heat:** Chapters 13 - 18 and chapter 21
Heat and Temperature Thermometers
Expansion of Solids
Expansion of Liquids
Expansion of Gases
Specific Heat Thermal Capacity, etc.
Latent Heat
Mechanical Equivalent of Heat
3. **Electricity:** Chapters 33, 34, 36 up to and including "Solenoid" 37, 38 and 39.
Electrostatics
Chemical Effect of the Electric Current
Current Measured by its Magnetic Effect
Ohm's Law and its Application
Electromagnetic Induction
Electricity as Energy

- (c) In addition to the above, it will be very desirable to commence the course by teaching the Metric System of measurement. (See Experiment 1, *Laboratory Exercises*.)

BIOLOGY 32

Primary Reference:

**Biology in Daily Life*, Curtis and Urban

Secondary References:

Elements of Biology, Dodge, Smallwood, Reverley, Bailey

Exploring Biology, Ella Thea Smith

Modern Biology, Moon, Man and Otto

A Laboratory Course in Biology, Rempel

Unit 1—A Survey Of All Living Things

References:

Biology in Daily Life, pp. 17 - 57; 511 - 569

Elements of Biology, pp. 4 - 36

Exploring Biology, pp. 5 - 112

Modern Biology, pp. 53 - 86

Unit 3—Green Plants Make The Food Used By All Living Things

References:

Biology in Daily Life, pp. 197 - 276

Elements of Biology, pp. 293 - 348

Exploring Biology, pp. 201 - 216

Modern Biology, pp. 444 - 513

Unit 4—Foods and Metabolism

References:

Biology in Daily Life, pp. 197 - 276

Elements of Biology, pp. 293 - 348

Exploring Biology, pp. 201 - 216

Modern Biology, pp. 444 - 513

Unit 5—The Conquest Of Disease

References:

Biology in Daily Life, pp. 277 - 354

Elements of Biology, pp. 389 - 410

Exploring Biology, pp. 245 - 316

Modern Biology, pp. 559 - 606

Unit 6—The Behavior Of Living Things

References:

Biology in Daily Life, pp. 428 - 464

Elements of Biology, pp. 349 - 376

Exploring Biology, pp. 317 - 360

Modern Biology, pp. 514 - 534; 499 - 507

Unit 7—Reproduction Of Living Things

References:

Biology in Daily Life, pp. 428 - 464

Elements of Biology, pp. 570 - 573

Exploring Biology, pp. 361 - 422

Modern Biology, pp. 170 - 195

Unit 8—Variation And Heredity

References:

Biology in Daily Life, pp. 465 - 509

Elements of Biology, pp. 575 - 588, 604 - 632

Exploring Biology, pp. 423 - 504

Modern Biology, pp. 607 - 668

Unit 9—The Kinds Of Living Things

References:

Biology in Daily Life, pp. 513 - 569

Elements of Biology, pp. 589 - 603

Exploring Biology, pp. 27 - 112

Modern Biology, pp. 219 - 424

SCIENCE 12 (Interim)

Introduction:

It seems reasonable that all students should have an opportunity to gain some knowledge of the field of science, but all students do not have the ability nor the desire to follow a matriculation program of studies in science. The Alberta Royal Commission on Education expressed, in recommendation 69, the need for a survey-type course in physical science for students attempting a non-matriculation program. These students would be, in many cases, those who attain a low standing in science on the Grade IX Departmental Examination. The course in Science 12 could be an introduction to Science 10 or it could be terminal in nature. In Science 12 the appropriate treatment of the subject matter would have, no doubt, a great emphasis

on experimental work and would be less mathematical than the approach in Science 10.

The Science 12 text is *Physical Science for Canadian High Schools*, by Hogg, Cross and Little.

The course consists of four units:

Unit 1

A. The Nature of Things, to include chapters:

3. Atoms and Molecules
4. Molecules in Motion
5. Air, an Important Mixture
6. Water, an Important Compound
7. Water for Machines

B. The Chemical Nature of Things, to include chapters:

53. Chemical Activity
54. The Shorthand of Chemistry
55. What are Ions?

Unit 2

A. The Earth, to include chapters:

8. The Earth and its Motions
9. Rocks of the Earth
10. The Changing Earth
11. The Record of Rocks
12. Life in Earth History

B. The Universe, to include chapters:

58. The Sun
59. The Sun's Family
60. Comets, Meteors and the Moon
61. Beyond the Solar System

Unit 3

Fire and Fuels, to include chapters:

22. What is Fire?
23. Oxidation
24. Fires and Explosions
25. The Control of Fire
26. Oil and its Origin
27. Coal and its Origin
28. Fuel Gases
29. The Carbon Dioxide Cycle

Unit 4

Weather, to include chapters:

18. Winds and Air Masses
19. Fronts and Storms
20. Weather Forecasting
21. What is Climate?

Experiments and Demonstrations

In any experiment there is a problem to be solved. Sometimes the problem may be to verify the results obtained by scientists, but there is still an element of discovery present because the outcome is not fully known beforehand. Some typical verification experiments are:

- (a) finding the weight of a volume of air.
- (b) determining the effect of like and unlike magnetic poles on one another.

Experiments that fail to verify known results should not be considered failures in the educational sense. Analysing the experiment and finding where it went wrong might develop the knowledge and thinking of a class as much as watching a successful verification.

As often as possible actual problems that exist should be solved by designing and carrying out pupils' experimental procedures. The problems to be answered might be of this type:

- (a) Which expands more when heated, iron or aluminum?
- (b) Do moist iron filings rust faster in air or in oxygen?
- (c) What is the relative humidity of the air in the classroom?

A demonstration differs from an experiment in that it is conducted by an "expert" who already knows what the outcome will be. The expert may be a teacher or a pupil, who under supervision, previously conducted the activity as an experiment. In the demonstration the expert is repeating the activity and attempting to lead others to the same conclusions reached in the original experiment.

Usually, a demonstration is conducted by one or more demonstrators in the presence of several observers. In an experiment small committees are usually working without spectators.

Experiments and demonstrations are not ends in themselves; their purpose is to encourage scientific thinking on the part of the class. Though the generalizations to be learned are prescribed, the experimental work leading to these may be flexible. Different experiments may be used from year to year and frequently a teacher should set groups working on different experiments, each leading to the same goal.

The recording of an experiment is a valuable experience for pupils but is of secondary importance. There should be rather complete notes on a few of the key experiments, but on minor experiments and demonstrations a brief note on each will suffice. The most important parts of an experiment are the planning, the observation and the critical thinking. Notes copied from a chalkboard or textbook on experiments that have never been performed are of no value to the pupils, regardless of how neat or well-colored the diagrams may be.

It has often been said, and rightly so, that a science course is not a science course unless there is experimentation and demonstration.

Enrichment

The purpose of enrichment in science is primarily to give pupils a better understanding of the generalizations. In other words, the concepts are being enriched.

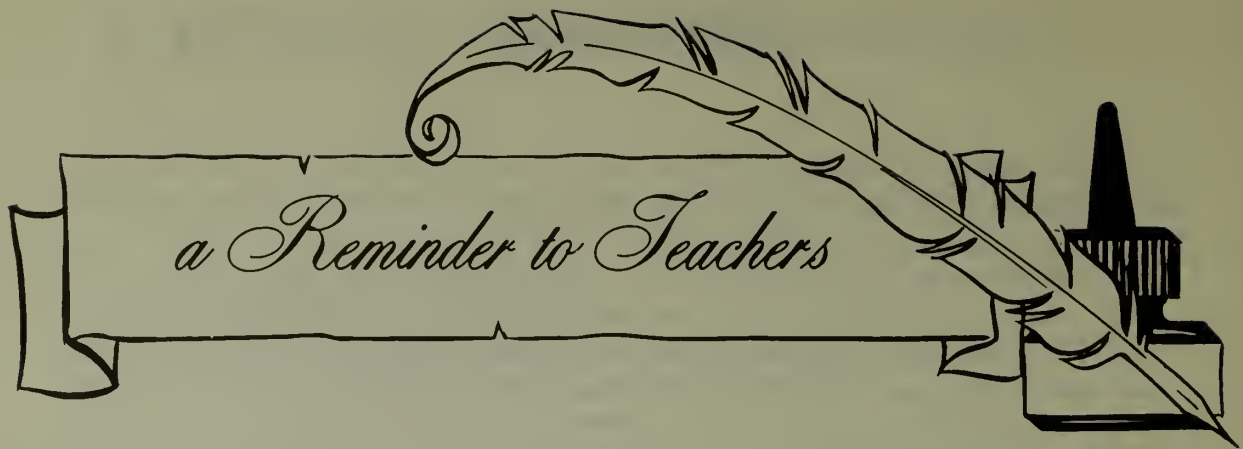
Enrichment can be carried out in two general ways. First, the pupils may be given material beyond the scope of the ordinary subject matter. This is usually termed "vertical" enrichment. Second, the pupils may be given additional experiences within the limits of the areas as outlined in the course. This may be referred to as "horizontal" enrichment.

The first method, actually a variation of acceleration, has definite drawbacks. At the time it may appear satisfactory but subsequent repetition may lead to obvious difficulty. This vertical type of enrichment may be used to advantage in areas that do not occur in a science course to be studied in later grades. In a case of this kind there is no reason why a teacher should not have a group of pupils go as far beyond the course requirements as time, pupil interest and ability permit.

The horizontal method of enrichment is usually the more desirable. Because much of the reading material must come from other than standard texts a teacher is required to become familiar with the science books in the library and also to gather together as much pertinent material as possible from current magazines. In addition, this type of enrichment calls for the fullest possible pupil participation in terms of experiments and demonstrations.

Enrichment is needed particularly by superior pupils who are not sufficiently challenged by the regular course requirements. However, there will be occasions when others of only average ability will become sufficiently interested to warrant enrichment. There is very little point in suggesting enrichment projects to pupils of low interest or low ability.

Finally it must be pointed out that enrichment exercises found in this guide are merely suggestive. They are intended for the teacher who has neither the time nor the specialized training in science to plan additional experiences for special students. The keen science teacher will think of many enrichment activities to supplement those listed. The real key to the selection of enrichment activities is the interest shown by the pupil.



Some of the science equipment required for the new Grade IX course was not needed previously, therefore teachers are reminded to check the material listed on page 65 and to order, well in advance, any additional supplies needed.

Many teachers have adopted the wise practice of asking pupils to bring to the classroom discarded material such as the following:

- used thermostats
- old eyeglasses
- small gasoline engines
- automobile parts—
 - water pump
 - carburetor
 - ignition coil
 - spark plug

Throughout the year teachers should collect magazine articles and news items dealing with rockets, missiles, artificial satellites, etc. See Classroom Aids for sources of materials pertaining to all units.

INTRODUCTION

WHAT IS SCIENCE?

The introductory chapter in Basic Physical Science attempts to set the stage for a problem-solving approach to the study of science. Junior High School students should learn the techniques of solving problems scientifically. In order that they may master these techniques, opportunities must be provided for them to deal with new problems developed by the teacher or the class. It is very likely that in the future the Grade IX Departmental Examinations will test the ability of the students to outline methods which might be used in the solution of problems he meets for the first time. An example of this type of problem follows:

PROBLEM:

Does the air around us contain something that causes food to spoil when exposed to it?

The solution of such a problem might be:

Materials:

Some fresh meat, two test tubes with well-fitting rubber stoppers, a tall beaker, retort stand, wire gauze, piece of glass and a source of heat.

Method:

Thoroughly wash and sterilize both test tubes with boiling water. Label them No. 1 and No. 2. Fill each test tube half full of the meat and fit the rubber stopper loosely in the top of each. Now stand both test tubes upright in the beaker which has been partially filled with water and cover the beaker with a glass plate. Heat the beaker and boil the contents for 20 minutes. While the water is boiling remove each test tube and at once force the stopper firmly into No. 1 test tube. Let the stopper remain loosely fitted in No. 2 test tube. After both test tubes have cooled, force the loose stopper firmly into place. Set them in a test tube rack in the classroom. Examine the contents daily but do not open either tube.

Observations and conclusions:

Observations and conclusions cannot be given here since the pupils have not actually performed the experiment.

Pupils should record with considerable care the details that are actually observed, not those that a text or reference states should be observed.

Any conclusions reached should be based on the actual observations.

Frequently the solution of problems will result in the setting up of experiments in which a series of procedures must be performed each with its attendant observation and partial conclusion. In such cases a form such as follows might reasonably be used.

Problem—To collect oxygen

Apparatus—bunsen burner, oxygen generator, pneumatic trough collecting bottles, potassium chlorate, manganese dioxide, water.

Procedure	Observation	Conclusion
1. Set up apparatus as shown.	Manganese dioxide a black powder very fine particles.	Mixture formed.
2. Thoroughly mix manganese dioxide and potassium chlorate. Fill test tube to a depth of not more than 1" with the mixture.	Potassium chlorate white crystals fine particles. No reaction when mixed.	
3. Set up collection apparatus.	Gas bubbles appear almost instantly and bubble up to displace water. This production is continuous.	Manganese dioxide lowers the temperature at which gas oxygen is given off.
4. Apply heat gently.	Bubbles are colorless.	Oxygen is insoluble or only slightly soluble in water (research check). Oxygen is a colorless gas.

Page 16 on experiments and demonstrations should be read carefully by all teachers. The last three paragraphs especially are important.

UNIT I — GRADE IX

MEASUREMENT

Suggested Time—1 week

References:

Hogg: *Basic Physical Science*, Van Nostrand

Van Hoff: *Our Environment: How We Use and Control It*, Allyn & Bacon

Adair et al: *Science, Discovery and Progress*, Clarke, Irwin & Co.

Laboratory Apparatus and Material:

Meter Sticks, with clamps and support

Spring Balances

Equal arm balance and weights



Experimenting with Science

UNIT I

MEASUREMENT

Content	Suggested Treatment
I. Measurement	
A. British and Metric Units	Discussion or report: The part measurement plays in science.
B. Converting Units	Practice measurement of length using British and Metric Systems.
II. Mass and Weight	
	Obtain conversion units by measurements followed by calculation.
	Use spring and equal arm balances to measure weights. Discussion or reading and report: The differences between mass and weight.
	Compare the weight of a man on the earth with his weight on the moon.
	Use British and Metric Units in simple problems.

UNIT I

MEASUREMENT

Aids and References

Basic Physical Science, pp. 11 - 17

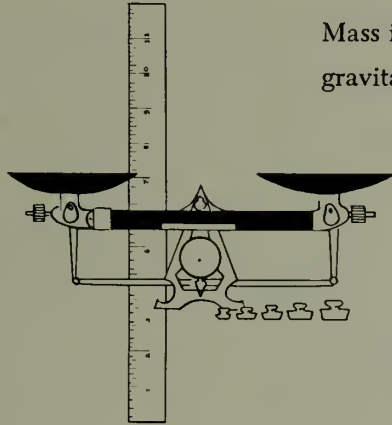
Science, Discovery and Progress, pp. 7 - 8, 11 - 12

Our Environment, How We Use and Control It, p. 120

Understandings and Generalizations

Measurement is basic to all science.

Solar System (Wall Chart)



Mass is a quantity of matter and weight is the result of gravitational force on matter.

UNIT II—GRADE IX

LIGHT

Suggested Time—4 weeks

References:

Hogg: *Basic Physical Science*, Van Nostrand

Adair et al: *Science, Discovery and Progress*, Clarke, Irwin & Co.

Burns et al: *Physics—A Basic Science*, Van Nostrand

Grolier Society: *The Book of Popular Science*

Beauchamp et al: *Science Problems No. 3*, Scott Foresman

Filmstrips:

Light and Its Characteristics (Curriculum)

The Eye and Optical Appliances (Curriculum)

The Telescope and Science (Curriculum)

Apparatus:

Carbon sticks

Burette clamps

Asbestos strips

Insulated wire

File

Fluorescent tube

Flashlight

Lens—Concave and Convex

Florence flask (large)

Box camera

Strontium chloride

Sandpaper

Electric Hot Plate

Support stands

Light bulb

(200 watt clear glass)

Magnifying glass

Small mirrors

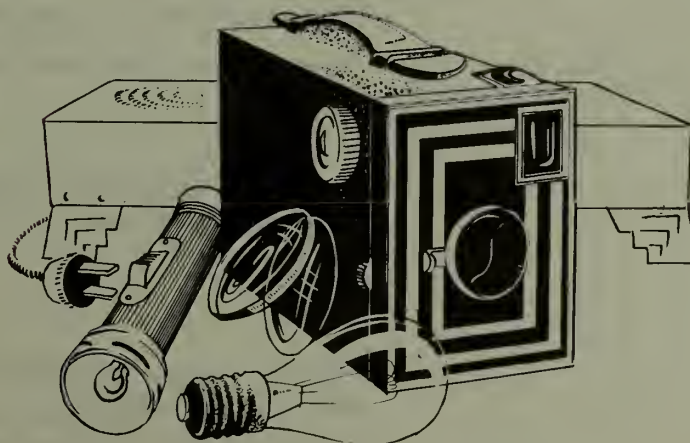
Prism

Mirrors—Concave and Convex

Roll of photographic film

Bunsen or alcohol burner

Copper chloride



UNIT II

LIGHT

Content	Suggested Treatment
I. Illumination	
A. Sources of Light	Short review of the history of artificial lighting.
1. Carbon Arc	Experiment: Make a carbon arc.
2. Carbon Filament	Discuss filament lamps.
3. Tungsten Filament	Experiment: Examine an incandescent lamp. Note behaviour of tungsten filament in air.
4. Vapor Lamp	Experiment: Light from gases. Discuss types of lights utilizing gases and examine actual fixtures. Enrichment Suggestion: Construct a model of an incandescent lamp. Read and do experiments.
II. Light and Effects	
A. Reflection of Light	Experiment: Reflect light from a mirror and note light paths.
1. Image in a Plane Mirror	Experiment: To show the position of the image in a plane mirror
2. Mirror Images Reversed	Show filmstrip. Discuss laws of reflection, using diagram to illustrate.
B. Refraction of Light	Experiment: Seeing over edge of dish by refraction. Experiment: Law of refraction. Illustrate refraction by diagrams.
C. Lenses	Discuss concave and convex lenses. Experiment: Use a convex lens to concentrate the rays of the sun. Enrichment Suggestions: Read further and do additional experiments, excluding mirrors and lenses.
III. Optical Instruments	
A. A Simple Camera	Examine a simple box camera and discuss its principles of operation.
B. The Eye	Make a diagram of the eye and show the similarity between it and the camera. Show filmstrip.

UNIT II

LIGHT

Aids and References

Understandings and Generalizations

Basic Physical Science, pp. 193-198

Book of Popular Science, Vol. 9, pp. 3761-3776

Science, Discovery and Progress, pp. 269-273

Book of Popular Science, Vol. 6, pp. 2411

Book of Popular Science, Vol. 8, pp. 3083-3085

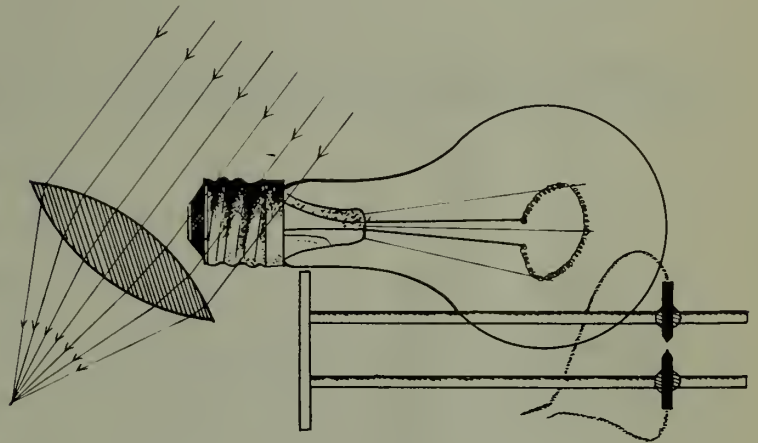
Basic Physical Science, pp. 199-206

Physics, A Basic Science, pp. 273-300

Filmstrip—*Light and Its Characteristics*

Science Problems No. 3, pp. 173-193

When the need arose man discovered methods of producing artificial light. The search for more effective methods has never ceased.



It has been possible to formulate laws concerning the behaviour of light since its effects occur in a systematic manner under similar conditions.

Book of Popular Science, Vol. 8, pp. 3085-3088

Basic Physical Science, pp. 207-216

Physics, A Basic Science, pp. 303-307

Filmstrip—*The Eye and Optical Appliances*

UNIT II

LIGHT

Content	Suggested Treatment
C. The Telescope	Discuss types of telescopes and telescopic photographs. Report: The Palomar Telescope. Show filmstrip. Enrichment Suggestion: Make a pinhole camera.
IV. Color	Discuss the nature of color.
A. Spectrum	Experiment: Formation of a spectrum. Discuss the rainbow.
B. Colors of Objects	Experiment: Colors of objects illuminated by light of different colors.
1. Color of Sky	Discuss variation in color.
2. Color of Sunset	Discuss reason for coloring.
3. Color and Safety	Report on choice of colors.
C. Light Waves	Discuss light travel and wave length.
1. Heat and Color	Discuss wave lengths and heat.
2. The Spectroscope	Report: The spectroscope.
a. Infrared Light	Report: Infrared light and its uses.
b. Ultraviolet Light	Report: The ultraviolet light band.
Electromagnetic Spectrum	Report: Radio waves, gamma rays and the x-rays. Enrichment Suggestions: Read further on x-rays. Do experiments with color listed in references.

UNIT II

LIGHT

Aids and References

Physics, A Basic Science, pp. 311-314

Filmstrip—*Telescope and Science* (Carr)

Book of Popular Science, Vol. 8, p. 3086

Basic Physical Science, pp. 217-228

Science, Discovery and Progress, pp. 250-262

Physics, A Basic Science, pp. 325-330

Physics, A Basic Science, pp. 261-264

Physics, A Basic Science, pp. 320-323

Physics, A Basic Science, pp. 496-497

Book of Popular Science, Vol. 7, pp. 2681-2688

Book of Popular Science, Vol. 8, pp. 3088-3090

Understandings and Generalizations

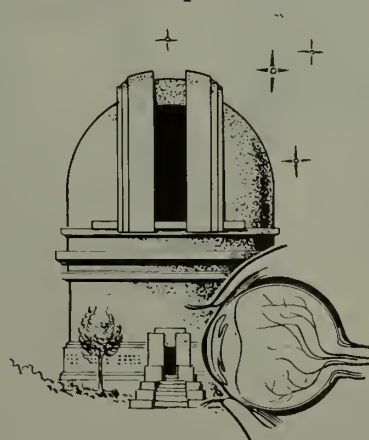
Knowledge of the ways in which light behaves made possible the invention of lenses which in turn made possible the invention of many modern optical instruments.

White light is composed of a combination of colors occurring in the visible spectrum.

Color is the result of partial absorption and consequent subtraction of one or more colors from the spectrum.

Beyond the limits of the visible spectrum there are wave lengths that are invisible. Ultraviolet waves and the infinitely short waves of cosmic rays occur at the violet end of the spectrum, and the infrared waves of heat and the long waves of radio are found at the red end of the spectrum.

Man has made use of wave lengths beyond the limits of the visible spectrum.



SUMMARY OF EXPERIMENTS FOR UNIT II

LIGHT

1. Make a carbon arc.
2. Examine an incandescent lamp.
3. Light from gases.
4. Reflect light from a mirror.
5. Show an image in a plane mirror.
6. Law of refraction.
7. Show refraction over edge of dish.
8. Concentrate the rays of the sun, by means of convex lens.
9. Show the formation of a spectrum and the rainbow.
10. Show how colors of objects change under different lights.

UNIT III

COMBUSTION AND FUELS

Suggested Time—7 weeks

References:

- Hogg: Basic Physical Science, Van Nostrand
J. E. Adair et al: *Science, Discovery and Progress*,
Clarke, Irwin & Co.
Van Hooft: *Our Environment, How We Use and
Control It*, Allyn & Bacon
Beauchamp et al: *Science Problems, Book I*, Scott
Foresman
Beauchamp et al: *Everyday Problems In Science*, Scott
Foresman
Brooks and Tracy: *Modern Physical Science*, Henry
Holt & Co.

Apparatus:

- | | |
|--------------------|-----------------------|
| Steel wool | Bunsen burner |
| Florence flasks | Copper wire |
| Glass tubing | Kerosene |
| Stoppers | Beakers |
| Potassium chlorate | Lycopodium powder |
| Test tubes | Calcium chloride tube |
| Retort stand | Gasoline |
| Clamps | Baking soda |
| Alcohol burner | Vinegar |
| Manganese dioxide | Rubber tubing |
| Lime water | Bottles |

Filmstrips:

- How We Get Our Oil* (McGraw-Hill)
Petroleum (N.F.B. P-2766)
Fires and Fuels (S.V.E. A491-5)
Coal (C.G.)
Gas (Y.A.F.)
How We Get Our Coal (Y.A.F.)

Films:

- Crude Oil Distillation* (Shell Oil Co.)
Our Common Fuels (Coronet)
Chemistry of Fire (Available Alberta Civil
Defence Office)

- | | |
|---------------------|----------------------|
| Water trough | Excelsior |
| Sulfur | Alum |
| Magnesium | Carbon tetrachloride |
| Charcoal | Coal |
| Combustion spoon | Condensing bottle |
| Hoffman's apparatus | Blue litmus paper |
| Sulfuric acid | T-tube |
| Iron filings | Methyl alcohol |
| Candles | Evaporating dishes |
| Milk bottle | Iodine |

Determining the composition of water.



UNIT III

COMBUSTION AND FUELS

Content	Suggested Treatment
I. Oxygen and Hydrogen	
A. Composition of Air	Experiment: The rusting of iron.
B. Elements and Compounds	Discuss the nature of elements and compounds.
C. Oxygen	
1. Preparation and Test	Experiment: Prepare oxygen using potassium chlorate. Test.
2. Catalyst	Experiment: Show that manganese dioxide aids the decomposition of potassium chlorate.
3. A Laboratory Method of Collecting a Gas	Experiment: Collect oxygen.
4. Oxygen and Combustion	Experiment: Burn sulfur in oxygen. Experiment: Burn magnesium in oxygen. Experiment: Burn carbon in oxygen.
5. Oxides	Discuss oxides. Use "word equations" to illustrate.
6. Molecules and Atoms of Oxygen	Discuss molecules and atoms of oxygen. Show briefly the use of symbols in making equations.
7. Types of Oxidation	Using examples, discuss the types of oxidation.
8. Uses of Oxygen	Discuss the uses of oxygen.
D. Hydrogen	
1. Preparation	Experiment: Prepare hydrogen using the electrolysis method only.
2. Chemical Reaction	Discuss the burning of hydrogen and formation of water vapor.
II. Fires and Their Control	
A. Candle Flame	Make a diagram showing the parts of the candle flame. Discuss the various zones and the reactions in the candle flame. Experiment: Is carbon dioxide and water vapor formed in a candle flame?
B. Gas Burner	Make a diagram of a Bunsen burner labelling the parts. Discuss the purpose of each part and how the burner works. Experiment: Show that the temperature of a Bunsen flame is higher than the melting point of copper.
C. Household Heaters	Discuss the differences between the Bunsen burner and household heaters such as stoves, furnaces, etc.

UNIT III

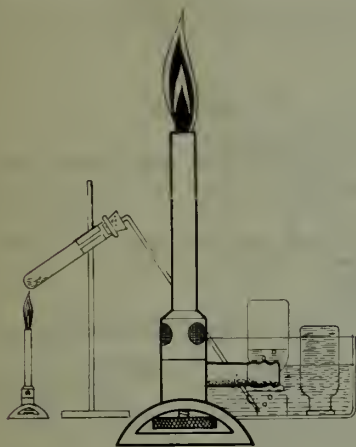
COMBUSTION AND FUELS

Aids and References

Science, Discovery and Progress, pp. 62-71

Our Environment, How We Use and Control It,
pp. 57-76

Basic Physical Science, pp. 91-99



Science, Discovery and Progress, p. 46

Basic Physical Science, pp. 100-112

Science, Discovery and Progress, pp. 75-84

Science Problems (Book I), pp. 182-223

Our Environment, How We Use and Control It,
pp. 51-56, 62

Everyday Problems in Science, pp. 72-97

Understandings and Generalizations

Air is a mixture of gases consisting mainly of nitrogen and oxygen with very small quantities of other gases.

Oxygen supports combustion.

A catalyst may speed up a chemical reaction.

Oxygen supports combustion but does not burn.

An oxide is a compound of oxygen and another element.

Hydrogen burns but does not support combustion.

A hydrocarbon is a compound of hydrogen and carbon.

Exothermic reactions are ones in which heat is given off.

UNIT III

COMBUSTION AND FUELS

Content	Suggested Treatment
D. Matches	Make a diagram of a match. Describe the two types of matches and show their similarities and differences.
E. Kindling Temperature	Explain what is meant by kindling temperature. Use examples to show that different substances have different kindling temperatures. Experiment: The kindling temperature of kerosene.
F. Dust Explosions	Discuss the causes of dust explosions and how to avoid them. Experiment: The burning of a powder.
G. Spontaneous Combustion	Explain the cause of spontaneous combustion and what we can do to remedy it.
H. Control of Fire	Discussion on great fires of the past, causes of fires, and methods of control. Experiment: Extinguish a gasoline fire by excluding air.
I. Fire Extinguishers	Discuss the purpose of the extinguisher. Experiment: Extinguish a candle flame by using carbon dioxide. Make a diagram of a soda-acid extinguisher. Experiment: Homemade extinguisher. Discuss the foamite extinguisher. Experiment: Make foamite. Discuss the dry carbon dioxide extinguisher and its value. Discuss the carbon tetrachloride extinguisher, its advantages and disadvantages. Omit experiment XI-9 in text, page 111. Discuss why flameproofing is necessary, its effectiveness and how it is done.
J. Flameproofing	Visit your local fire department to find out what is done in your community by way of fire protection.

UNIT III

COMBUSTION AND FUELS

Aids and References

Civil Defence film:

Chemistry of Fire

Understandings and Generalizations

The kindling temperature of a substance is the temperature to which the substance must be heated before it will burn.

Spontaneous combustion is a fire started without the help of an external source of heat.

Fires can be controlled by cooling the burning substance below its kindling temperature, by excluding air, or by removing the fuel supply.



UNIT III

COMBUSTION AND FUELS

Content	Suggested Treatment
III. Coal, A Fossil Fuel	
A. Origin of Coal	Review the origin of coal.
B. Kinds	Discuss the importance of carbon content in determining the kind and hardness of coal. Show filmstrip.
C. How Coal is Formed	Explain the actual processes which occur in formation of coal. Make graphs showing the percentages of carbon, oxygen, hydrogen and nitrogen in wood, peat, lignite, bituminous coals and anthracite.
D. Location of Coal Fields	Make a map of the world showing important coal fields. Make a map of Canada showing important coal fields.
E. Mining of Coal	Discuss the problems encountered in the mining of coal. Show filmstrip.
F. Uses of Coal	Discuss the uses of coal as a fuel, in producing electricity, etc.
G. Distillation of Coal	Experiment: The destructive distillation of coal. Make a diagram of a coke oven. Discuss the processes that go on in a coke oven and the uses of coke. Discuss the importance of coal gas and its uses. Explain the reaction in a coal gas flame. Discuss the importance of coal tar and light oil derived from the distillation of coal.
IV. Oil and Natural Gas	
A. Early Uses	Discuss early uses of oil. Make a map of the world showing the major oil fields.
B. The World's Oil Supply	Make a map of Canada showing the oil fields.
C. The Location of Oil	Show filmstrip. Review the formation of oil. Report: How the geologist attempts to locate oil.
D. Oil Drilling	Report: The drilling for oil. Show filmstrip.

UNIT III

COMBUSTION AND FUELS

Aids and References

Basic Physical Science, pp. 113-120

Science, Discovery and Progress, pp. 76-78

Our Environment, How We Use and Control It,
pp. 128-135

Filmstrip—*Coal*

Understandings and Generalizations

Vegetation, under proper conditions first changes to peat, then to lignite, then to bituminous coals, and finally to anthracite.

Coal is formed by the slow decomposition of plant material compressed by overlying strata.



Filmstrip—*How We Get Our Coal*

Destructive distillation is the decomposition of a complex substance by heat and the condensation of some of its vapors.

Coke, tar, and coal gas are formed in the distillation of coal.

Basic Physical Science, pp. 121-129

Science, Discovery and Progress, pp. 597-617

Modern Physical Science, pp. 136-148, 154-155

Filmstrip—*How We Get Our Oil*

The original source of most oil is diatoms.

Scientific knowledge and equipment are used in finding oil.

Filmstrip—*Petroleum*

UNIT III

COMBUSTION AND FUELS

Content	Suggested Treatment
E. Refining Oil	With the aid of a diagram explain how oil is refined. Make a chart showing the various fractions of crude oil, condensation temperature and uses of each fraction. Show filmstrip.
F. Octane Number	Discuss what is meant by octane number and also discuss its importance.
G. Natural Gas	Discuss where natural gas is found, how it is located, how it is drilled for, and its uses. Make a map of Canada locating important gas fields. Show filmstrip.
H. Coal, Petroleum and Natural Gas	Discuss the importance of coal, petroleum and natural gas and review the uses of these fuels. Make a graph showing the percentage of heat energy supplied by each. Show filmstrip.
V. Carbon Dioxide and the Carbon Dioxide Cycle	
A. Carbon Dioxide	
1. Preparation	Experiment: Prepare carbon dioxide. Experiment: Test for an acid. Explain the chemical reaction of carbon dioxide and water.
2. Test for Carbon Dioxide	Experiment: A test for carbon dioxide. Explain the chemical reaction in testing carbon dioxide.
3. Some Properties	Experiment: Pour carbon dioxide on to a candle flame. Discuss carbon dioxide's density, and the fact that it is incombustible.
4. Part played in Respiration	Experiment: Compare the amount of carbon dioxide in ordinary air with that in exhaled air.
5. Part played in Photosynthesis	Discuss the importance of carbon dioxide in photosynthesis. Experiment: Extract chlorophyll from green leaves. (Caution: Alcohol fumes are dangerous.)
6. Photosynthesis, Combustion	Discuss the part played by carbon dioxide in photosynthesis and combustion.
B. The Carbon Dioxide Cycle	Make a diagram to illustrate the carbon dioxide cycle. Discuss this cycle.
C. Carbon Dioxide and Climate	Discuss the long range effect of carbon dioxide on our climate.

UNIT III

COMBUSTION AND FUELS

Aids and References

Understandings and Generalizations

Many useful products are obtained from crude oil.

Filmstrips—Crude Oil Distillation



Filmstrip—Gas

Natural gas is the most important fuel gas in industry in North America.

Coal, petroleum, and natural gas are the chief commercial sources of heat energy in Canada today.

Filmstrip—Our Common Fuels

Basic Physical Science, pp. 130-137

Science, Discovery and Progress, pp. 72, 73, and 493-495

Carbon dioxide turns limewater milky.

Carbon dioxide is heavier than air and does not support combustion.

Respiration is an oxidation process.

Any acid will turn blue litmus paper red.

Photosynthesis and combustion are reverse processes.

The circulation of carbon dioxide in nature is called the carbon dioxide cycle.

SUMMARY OF EXPERIMENTS FOR UNIT III

COMBUSTION AND FUELS

1. The rusting of iron.
2. Prepare oxygen using potassium.
3. Test oxygen (prepared above).
4. Show that manganese dioxide aids the decomposition of potassium chlorate.
5. Collect oxygen.
6. The combustion of sulfur in oxygen.
7. The combustion of magnesium in oxygen.
8. The combustion of carbon in oxygen.
9. Prepare hydrogen using electrolysis method only.
10. Find the percentage of oxygen and nitrogen in the air.
11. Is carbon dioxide and water vapor formed in a candle flame?
12. Show that the temperature of a Bunsen flame is higher than the melting point of copper.
13. The kindling temperature of kerosene.
14. The burning of a powder.
15. Extinguish a gasoline fire by excluding air.
16. Carbon dioxide extinguishes a candle flame.
17. A homemade extinguisher.
18. Make foamite.
19. The destructive distillation of coal.
20. The destructive distillation of wood.
21. Prepare carbon dioxide.
22. Test for an acid.
23. A test for carbon dioxide.
24. Pour carbon dioxide on to a candle flame.
25. Compare the carbon dioxide in ordinary air with that in exhaled air.
26. Extract chlorophyll from green leaves.
27. Show that starch is formed in photosynthesis.

Additional Experiments: To show that wood, sulphur, paper and coal have different kindling temperature (apply uniform source of heat and note time required).

UNIT IV —GRADE IX

HEAT AND TEMPERATURE

Suggested Time—8 weeks

References:

Hogg Cross: *Basic Physical Science*, Van Nostrand.

Eubank et al: *Basic Physics*, MacMillan.

Apparatus:

Metal ball and ring
Bimetal strip
Copper tubing
Aluminum tubing
Thermostat
Copper gauze
Convection current apparatus

Radiometer
Heating coil
Thermos flask
Clinical thermometer
Hygrometer
Potassium permanganate



Observing convection currents.

UNIT IV

HEAT AND TEMPERATURE

Content

I. Effects of Heat

A. Expansion and Contraction

1. Observations

Suggested Treatment

Common observations:

- Expansion of mercury or alcohol in a thermostat.
- Concrete highways, sidewalks, driveways, patios, etc. are laid in sections with spaces between filled with soft asphalt, wood, tén test or similar material. Discuss what would happen if this were not done.
- Weathering of rocks (Grade VII). Repeated expansion and contraction.
- Steel bridges built in sections with spaces between sections and on rollers. (Interlock fingers), e.g. Golden Gate Bridge (3 feet change). Others—High Level Bridge, Edmonton. C.P.R. bridge, Lethbridge.
- Steam pipe construction.
- Glass; Why hot water poured into glass jars often cracks them. Pyrex glass, thin glass vessels.

2. The Common Thermostat

What happens to the volume of solids when they are heated? Cooled?

Experiments:

- Experiment 15-1 (use an aluminum tube, a copper tube, a glass tube).
- Ball and ring experiment.
- Screw and screw-eye experiment.

3. Molecular Theory

Discussion: "What causes expansion and contraction?"

4. Different Substances and the Expansion Ratio (Coefficient)

Experiment: To loosen a metal screw-cap on a jar.

Experiment: Do different metals expand at different rates? (Bimetal strip.)

5. Contraction on Cooling

Observations: Steel tires placed on railroad wheels; iron tires placed on wooden wheels; the use of steel rivets to tie beams together.

6. The Expansion of Liquids

Discuss: The expansion of mercury and alcohol in thermometers; the use of an expansion tank in a hot-water heating system.

Experiment: The expansion of water and the difference between water expansion and glass expansion and its effects.

UNIT IV

HEAT AND TEMPERATURE

Aids and References

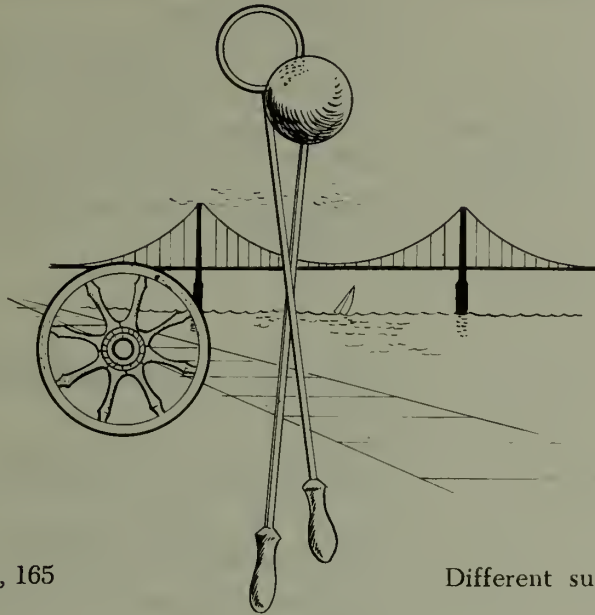
Basic Physics—Experiment No. 1, pp. 115, 164
—Experiment No. 2, pp. 115, 165

Basic Physical Science, pp. 141-150

Understandings and Generalizations.

Solids generally expand when heated and contract when cooled.

The rate and amount of expansion varies with different substances.



Basic Physics, pp. 155, 165

Different substances expand at different rates.

UNIT IV

HEAT AND TEMPERATURE

Content	Suggested Treatment
7. Water, a Peculiar Fluid	Why does ice form first at the surface of a lake? Discuss what would happen if ice formed at the bottom.
8. The Expansion and Contraction of Gases	Experiment: Construct a simple air thermometer and discuss its operation. Experiment: What happens when heat is applied to an inflated balloon? Experiment: How does reducing temperature affect the pressure of a gas? (Exp. 15-7). Demonstration: The cylinder of an air pump becomes warm as a tire is inflated. Explain. When air is allowed to escape from a tire it feels cool. Explain.
II. Transmission of Heat	
A. Conduction of Heat	Review the kinetic-molecular theory and apply it to solids. Experiment: The heat conductivity of copper gauze. (Note the safety lamp invented by Davy.) Discuss the relative conductivity of wood, cloth, plastic and glass with examples. Experiment: Compare the conductivity of wood and copper. Experiment: Test water as a conductor of heat. Discussion: Discuss gases as conductors of heat and their insulation value for housing, refrigeration, etc. Demonstration: Hold your hand immediately above a light bulb. What do you notice? Why?
B. Convection	Discussion: Why do we have winds? Why do we have land and sea breezes? Discuss the relation of high and low barometric pressures to winds. Demonstration: Show that convection currents operate in water and explain the reasons. Demonstration: The operation of a hot-water system.
1. Winds, Land and Sea Breezes	Discussion: The transfer of energy through space by radiation rather than by the motion of molecules.
2. Convection Currents in Water	Experiment: Show that heat from a metal ball is evident below the ball.
C. Radiation	

UNIT IV

HEAT AND TEMPERATURE

Aids and References

Understandings and Generalizations

Water expands when it freezes and becomes lighter volume for volume.

Gases expand when heated and contract when cooled.

Gases heat when compressed and cool when expanded.

Basic Physical Science, pp. 151-161

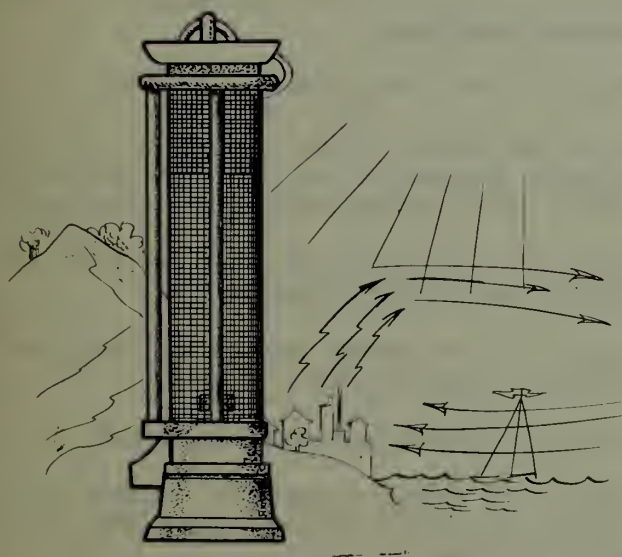
Some materials conduct heat well. Others are poor conductors.

Winds are caused by convection currents which set air in motion. This is a flow of molecules.

Convection may occur in liquids and gases.

Heat travels through a partial vacuum by means of radiation.

Radiant energy from the sun sustains life on earth.



UNIT IV

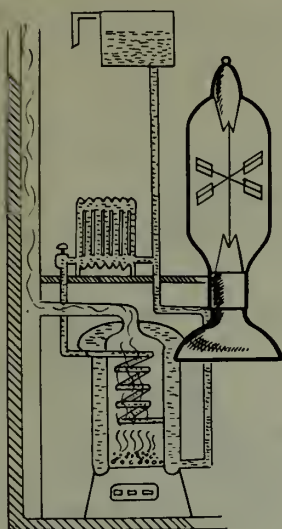
HEAT AND TEMPERATURE

Content	Suggested Treatment
D. Absorption of Heat	Observations: —Dirty snow melts faster than clean snow. —Dark clothing is warmer in summer than light colored clothing. —Compare the temperature of the inside of a car with a light-colored top with that of one with a dark-colored top. Experiment: Use a radiometer to show the effect of absorption and radiation. Discussion: Heating systems in houses or other buildings and the use of convection currents, radiation and conduction for the purpose of distributing heat.
E. The Distribution of Heat	
III. Temperature	
A. Theory of Temperature	Discuss the fact that molecules move faster as they are heated.
B. Measurement of Temperature	
1. Touch	Experiment: Is touch a reliable measure of temperature?
2. Fahrenheit Thermometer	Demonstration: Set up an air thermometer, devise a scale to go with it and try to measure temperature with it. Discuss the history of the development of the Fahrenheit thermometer. Establish how the fixed points were decided.
3. The Centigrade or Celsius Scale	Discuss the history of the development of the Centigrade thermometer and the scale that was devised. Establish the fixed points. Discuss advantages. Experiment: Check the fixed points on both Fahrenheit and Centigrade thermometers.
4. Compare Fahrenheit and Centigrade Temperatures	Compare the relationship between 1 Centigrade degree and 1 Fahrenheit degree. Show how the conversion formulas are derived. Problems: Do enough problems to facilitate the conversion of any temperature reading from one scale to the other.

UNIT IV

HEAT AND TEMPERATURE

Aids and References



Basic Physical Science, pp. 162-171

Understandings and Generalizations

Good absorbers of radiant energy are good radiators or emitters of it.

Poor absorbers of radiant energy are poor emitters of it.

Heating systems make use of convection, radiation and conduction to distribute heat.

Temperature is a measure of the movement of the molecules of a substance.

There are two commonly accepted scales for measuring temperatures.

UNIT IV

HEAT AND TEMPERATURE

Content	Suggested Treatment
5. Measuring Body Temperature	Establish that normal body temperature of humans is 98.6° F. but that this may vary. Discuss the limits for health. Discuss the modern ways of maintaining comfortable temperatures in a home. Discuss the difference between warm and cold-blooded animals.
6. Special-purpose Thermometers	Examine a clinical thermometer and a meat thermometer. Discuss the automatic oven type of thermometer found in some stoves.
7. Mercury as a Thermometer Liquid. Alcohol as a Thermometer Liquid.	List the advantages and disadvantages of using mercury and/or alcohol as a thermometer liquid.
8. Low and High Temperatures	Discuss the uses of low and high temperatures. Establish the meaning of absolute zero. Discuss the temperatures of air, the sun, melting points of various substances, etc.
9. The Use of Color as an Indication of Temperature	Discuss the use of a pyrometer in measuring temperature. Experiment: Show that the temperature of a Bunsen burner varies at different points.
IV. Heat	Establish that substances may indicate the same temperature but because of size or quantity they may contain different amounts of heat.
A. What is Heat?	
B. Measurement of Heat	Establish the units of heat: 1. Btu; 2. Calorie. Establish the relation between 1 Btu and 1 calorie. Problems: Do enough problems to establish good understanding.
C. Heat Capacity of Substances	Discussion: Do land and water masses absorb the sun's heat at the same rate? Experiment: Compare the heat capacity of water and sand.
D. Heat from the Sun	General discussion and review of the effects of the heat from the sun. Discussion: The solar furnace; solar house heating.

UNIT IV

HEAT AND TEMPERATURE

Aids and References



Basic Physical Science, pp. 172-179

Understandings and Generalizations

Human life depends upon the maintenance of a narrow range of body temperature.

Many animals have a much greater temperature tolerance than man.

There are many ways of measuring temperature.

The type of measurement depends upon the range of temperature to be measured.

Temperature depends on the average speed of the molecules of a substance.

Heat depends on the number of molecules as well as their speed.

Nearly all energy comes from the sun.

UNIT IV

HEAT AND TEMPERATURE

Content	Suggested Treatment
E. Heat of Combustion	Set up tables showing calorie content of fuels and foods.
V. Evaporation of Liquids	Demonstrate evaporation and discuss the principles involved.
A. Cooling effect of Evaporation	Experiment: What happens to temperature when evaporation takes place?
B. Rate of Evaporation	Explain why evaporation occurs more rapidly in some cases than in others. Experiment: Do all liquids evaporate at the same rate?
C. The Water Cycle	Review.
D. Refrigeration	Experiment: Make ice by evaporation. Discuss.
E. Boiling	Experiment: Boil water and observe the successive steps involved.
1. Observations	
2. Pressure	Relate barometric pressure to boiling point at various altitudes. Experiment: Boil water under reduced pressure. Discussion: How long does it take to hard boil eggs at various places in Alberta, in the mountains, at sea-level?
3. Boiling Point at Increased Pressure	Experiment: How does the pressure cooker solve the problem of altitude?
F. Latent Heat of Vaporization	Establish the fact that the temperature of boiling water does not rise above 100° C. at sea-level and additional heating only increases the rate at which bubbles are released from the liquid. Show that steam and boiling water are at the same temperature. Discussion: The storing of latent heat during vaporization, and its release during condensation. Discussion: How steam heating uses the vaporization-condensation cycle.
G. Relative Humidity	Explain the terms: —Humidity. —Relative Humidity.

UNIT IV

HEAT AND TEMPERATURE

Aids and References

Basic Physical Science, pp. 180-190

Understandings and Generalizations

Fuels and foods, each releases a definite calorie content when oxidized.

The rate of evaporation depends on the particular liquid in question.

Evaporation causes cooling.



The boiling point of a liquid is the temperature at which its vapor pressure equals the pressure of the atmosphere.

Water boils at different temperatures at different pressures.

A pressure cooker not only solves the cooking problems at high altitudes but it greatly reduces the time of cooking at any altitude.

Latent heat of vaporization is the heat that changes a liquid to a vapor without changing the temperature.

Latent heat of vaporization is stored in a vapor till the vapor condenses.

$$\text{R.H.} = \frac{\text{water vapor actually present in the air}}{\text{maximum amount possible at that temperature}}$$

UNIT IV

HEAT AND TEMPERATURE

Content	Suggested Treatment
Relative Humidity (cont'd)	Discuss the effect of temperature change on relative humidity. Experiment: Use an hygrometer to find the relative humidity of the air in the classroom. Discuss the relationship between: —Relative humidity and health. —Relative humidity and comfort.
H. Dew Point	Discuss why dew often appears on the grass in the evening or morning. Experiment: Fill a beaker with cold water. Observe and explain the presence of moisture on the outside of the beaker. Relate your observation to dew point.

UNIT IV

HEAT AND TEMPERATURE

Aids and References

Understandings and Generalizations

Dew point is the temperature at which moisture begins to condense from the air.

**SUMMARY OF EXPERIMENTS AND DEMONSTRATIONS
FOR UNIT IV**

HEAT AND TEMPERATURE

1. What happens to the volumes of solids when they are heated?
 - (a) Expansion of a copper rod.
 - (b) Ball and ring experiment.
 - (c) Screw and screw-eye experiment.
2. To loosen a metal screw cap on a jar.
3. Do different metals expand at different rates?
4. The expansion of water and the difference between water and glass expansion and its effects.
5. Construct a simple air thermometer.
6. What happens when heat is applied to an inflated balloon?
7. How does reducing temperature effect the pressure of a gas?
8. The cylinder of an air pump becomes warm as a tire is inflated. When air is allowed to escape from a tire it feels cool.
9. Try the heat conductivity of copper gauze.
10. Compare conductivity of copper and wood.
11. Test water as a conductor of heat.
12. Hold your hand above a light bulb.
13. Show that convection currents operate in water.
14. How does a hot water system operate?
15. Show that heat from a metal ball is evident below the ball.
16. Use a radiometer to show the effect of absorption and radiation.
17. Is touch a reliable measure of temperature?
18. Set up an air thermometer and devise a scale to go with it.
19. Check the fixed points on both Fahrenheit and Centigrade thermometers.
20. Use a clinical thermometer.
21. Show that the temperature of a Bunsen burner varies at different points.
22. Compare the heat capacity of water and sand.
23. Demonstrate evaporation.
24. What happens to temperature when evaporation takes place?
25. Do all liquids evaporate at the same rate?
26. Make ice by evaporation.
27. Boil water.
28. Boil water under reduced pressure.
29. Use a pressure cooker.
30. Use an hygrometer to show relative humidity.
31. Condensation of water vapor.

UNIT V — GRADE IX

MACHINES

Suggested Time—9 weeks

References:

Hogg: *Basic Physical Science*, Van Nostrand

Adair et al: *Science, Discovery and Progress*, Clarke, Irwin & Co.

Van Hooft: *Our Environment: How We Use and Control It*, Allyn & Bacon

Lynde: *Science Experiences with Home Equipment*, Van Nostrand

Filmstrips:

Energy and Engines (E.B.F.)

Simple Machines (Curriculum)

Film:

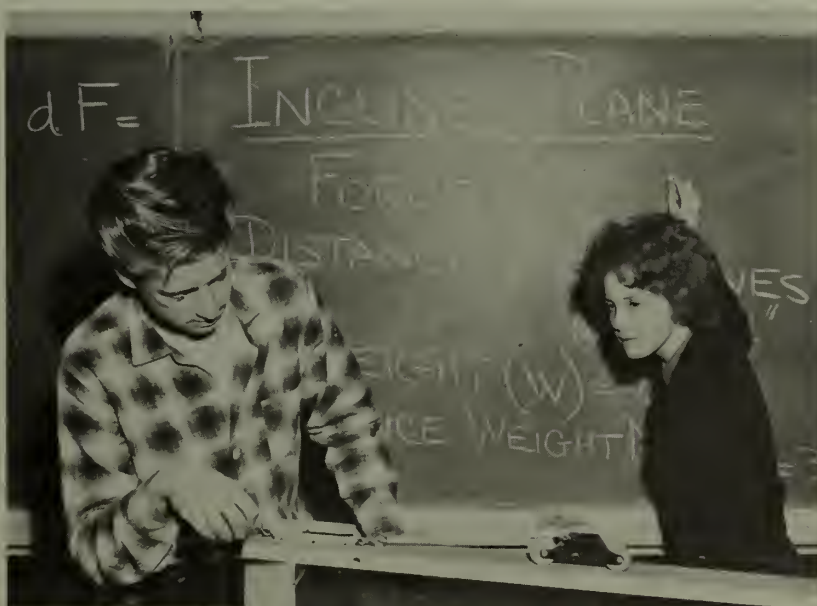
Hydraulics

Laboratory Apparatus and Material:

Friction block
Wheel and axle
Model of hydraulic press
Mercury barometer tube
Overflow can
Mercury

Pulleys—single and double
Jack screw model
Test tubes and clamps
Model lift pump
Sulfur

Inclined plane board and attachments
Pendulum bob
Burners
Model force pump
Archimedes' Triangle apparatus



Using an inclined plane.

UNIT V

MACHINES

Content	Suggested Treatment
I. Measurement	Discussion or report: The part measurement plays in science.
A. British and Metric Units	Practice measurement of length using British and Metric Systems.
B. Converting Units	Obtain conversion units by measurements followed by calculation.
II. Mass and Weight	Use spring and equal arm balances to measure weights.
	Discussion or reading and report: The differences between mass and weight.
	Compare the weight of a man on the earth with his weight on the moon.
	Use British and Metric Units in simple problems.
III. Force	Discuss the forces commonly found.
	Experiment: Are different amounts of force required to move a body?
	Experiment: Does friction depend upon the nature of the surfaces in contact?
	Discussion or report: Friction—Good and bad effects.
IV. Work	Demonstration and discussion: The force-distance product.
	Have the class use the equipment to obtain several force-distance products.
	Calculate a variety of products using gram-centimetres, ounce-inches, foot-pounds, etc.
	Reading and research: Units commonly used.
	Simple problems.
V. Efficiency	Experiment: To compute input and output work on an inclined plane.
	Discuss results to develop the concept of efficiency.
	Show filmstrip.
VI. Mechanical Advantage	Class activity: Calculate mechanical advantage by measurement of resistance and force and by measurement of distances that force and resistance move.
	Discuss the manner in which friction and machine weight affect the true mechanical advantage.

UNIT V

MACHINES

Aids and References

Basic Physical Science, pp. 11-17

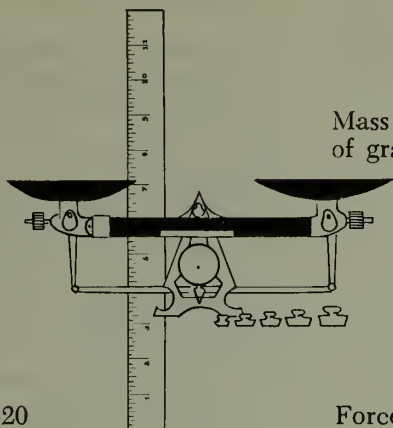
Science, Discovery and Progress, pp. 7-8, 11-12

Our Environment, How We Use and Control It, p. 120

Understandings and Generalizations

Measurement is basic to all science.

Solar System (Wall Chart)



Mass is a quantity of matter and weight is the result of gravitational force acting on matter.

Basic Physical Science, pp. 18-20

Science, Discovery and Progress, pp. 372

Our Environment, How We Use and Control It, p. 127

Force tends to produce directed motion or to prevent it.

Friction is often a useful force.

Basic Physical Science, pp. 20-24

Science, Discovery and Progress, pp. 368-369

Our Environment, How We Use and Control It, p. 126

When work is done displacement is in the same direction as the effective applied force.

Basic Physical Science, pp. 24-26

Science, Discovery and Progress, p. 373

Our Environment, How We Use and Control It, p. 134

Filmstrip—*Energy and Machines*

Work input is normally equal to output of work plus work done to overcome friction; however this generalization is accurate only if the weight of the machine doing the work is disregarded.

True mechanical advantage can be obtained only by measuring resistance and force when the machine is doing work and calculating the ratio of resistance to force.

UNIT V

MACHINES

Content	Suggested Treatment
VII. Power	Experiment: Measure rate of work using the inclined plane. Develop additional problems to those in the text if required for understanding.
VIII. Simple Machines	Discuss early uses of machines. Each machine should be discussed in a manner to reinforce the concepts of Work, Efficiency, Mechanical Advantage and Power that have been developed. Experiment: Use simple fixed, single, movable and multiple pulleys to further develop the preceding principles. Examine pulleys in common use (block and tackle, wire stretchers). Experiment: Use wheel and axle to further develop the above principles. Report: Various types of wheels and axles. Demonstrate that a screw is a spiralled inclined plane. Work simple problems based on pulleys and wheel and axle (problems on screw and wedge should be used for interest and explanatory value only).
A. Inclined Plane B. Pulley C. Wheel and Axle D. Screw E. Wedge	
F. Levers	Experiment: Balance a metre stick. Discuss the results to develop ideas of moments, clockwise and counter-clockwise rotation, equilibrium. Experiment: Determine the moments of force in the lever using balanced and unbalanced levers. Discuss the results to note effect of machine weight on work done.
1. Centre of Gravity 2. Moments	
IX. Energy	Experiment: Transformations of energy in a simple pendulum. Discuss common instances of transformation of potential energy into kinetic energy and kinetic energy into potential energy. Experiment: Can kinetic energy be changed to heat energy? Discuss the changing concept of conservation of energy. Report: Atomic energy and its uses.
A. Kinetic Energy B. Potential Energy C. Transformation of Energy D. Conservation of Energy E. Forms of Energy	

UNIT V

MACHINES

Aids and References

Basic Physical Science, pp. 26-27

Science, Discovery and Progress, p. 370

Our Environment, How We Use and Control It, p. 135

Filmstrip—Simple Machines

Basic Physical Science, pp. 30-41

Science, Discovery and Progress, p. 371

Our Environment, How We Use and Control It, p. 129

Understandings and Generalizations

Power is the rate of doing work.

Machines may multiply a force, multiply speed or change the direction of a force; they never increase work.

Basic Physical Science, pp. 43-50

The weight of a body acts at its centre of gravity.

The turning effect or moment of a force depends upon the distance from the turning point at which the force acts.

Basic Physical Science, pp. 53-59

Energy is the ability to do work.

Science, Discovery and Progress, pp. 6, 15-19

Energy cannot be created nor destroyed.

Our Environment, How We Use and Control It, p. 122

Matter can be converted to energy.

UNIT V

MACHINES

Content	Suggested Treatment
X. Properties of Gases	Experiment: Show that gas molecules move.
A. Molecules and Matter	Experiment: Does a gas exert pressure?
B. Molecular Speed and Heat	Discuss the kinetic theory and its relation to pressure.
C. Molecular Speed and Weight	Activity: Construct a barometer and record the readings for several days.
D. Gas Pressure	Report: Effect of altitude on air pressure.
E. Measurement of Gas Pressure	For further class activities to clarify ideas see Lynde—"Science Experiences with Home Equipment".
XI. Properties of Liquids	Demonstration or construction and discussion: Water wheels and turbines; using the weight of water to do work.
A. Liquid Pressure	Experiment: To find the effect of depth on water pressure.
B. Transmission of Pressure	Experiment: Is pressure in a liquid transmitted in all directions?
	Study one or two machines from the following to find out how they make use of these principles—hydraulic jack, lift, press, etc.
XII. Forms of Matter	Activity: Use heat to change sulfur from a solid, to a liquid and to a gas.
	Discuss results to bring out the characteristics of the forms of matter in terms of the kinetic-molecular theory.
XIII. Machines Using Certain Liquids and Gas Properties	Examine models of lift and force pumps.
A. Lift Pumps	Explain their operation using written or oral language.
B. Force Pumps	
XIV. Buoyancy	Experiment: Compare the weight of a body in air with its weight in water.
	Demonstrate Archimedes' principle.
	Discuss the applications of the results.

UNIT VI — GRADE IX

ENERGY AND TRANSPORTATION

Suggested Time—5 weeks

References:

Hogg & Cross: *Basic Physical Science*, Van Nostrand

Adair et al: *Science, Discovery and Progress*, Clarke, Irwin & Co.

Van Hooft: *Our Environment, How We Use and Control It*, Allyn & Bacon

Apparatus:

Model steam engine

Rubber tubing

Glass tubing

Test tubes

Induction coil

Spark plug

Venturi tube

Model gasoline engine



Experimenting with model steam engines

UNIT VI

ENERGY AND TRANSPORTATION

Content

Suggested Treatments

I. Steam Engines

Experiment: Show the expansive force of steam.

A. Reciprocating Engines

Examine a toy steam engine to note the parts and principles of operation with oral and/or written explanations.

1. The Cylinder

Make a report with diagrams on the slide-valve steam engine.

2. Efficiency

Report: Heat losses in the steam engine.

Enrichment: Newcomen.

B. Steam Turbines

Experiment: Show how a steam turbine operates.

1. Working Principles

Reading and Report: Advantages of the steam turbine.

Compare turbines and reciprocating engines.

C. Transmission of Power

Examine bicycles, appliances, toys, etc. Note use of belts and gears.

1. Belts and Gears

Construct belt drives and gear trains using Meccano or other construction media.

Demonstrate the principle of the carburetor.

Examination of a carburetor to note the parts.

Make oral and/or written explanations and diagrams.

Use models or preferably an old motor to note the parts and explain their operation.

Make oral and/or written explanations with diagrams.

II. Internal Combustion Engines

A. Vaporization of Fuel

1. Bernoulli Effect

Enrichment: Transmission of Power—clutch, transmissions, differential.

B. Gasoline Engines

1. Four-stroke (Cycle) Engines

Report or discussion: Comparison of the gasoline engine and the diesel engine.

C. Diesel Engines

1. High Compression Engines

Use models or small glo-plug type airplane motors to explain two-stroke principles.

2. Four-stroke (Cycle) Diesels

3. Two-stroke (Cycle) Diesels

UNIT VI

ENERGY AND TRANSPORTATION

Aids and References

Basic Physical Science, pp. 233-234

Science, Discovery and Progress, pp. 406-407

Our Environment, How We Use and Control It, p. 351

Basic Physical Science, pp. 234-236

Science, Discovery and Progress, p. 407

Our Environment, How We Use and Control It, p. 354

Basic Physical Science, pp. 236-238

Science, Discovery and Progress, pp. 385-386

Basic Physical Science, pp. 240-241

Science, Discovery and Progress, p. 410

Our Environment, How We Use and Control It, p. 355

Basic Physical Science, pp. 241-248

Science, Discovery and Progress, p. 410

Our Environment, How We Use and Control It, p. 361

Basic Physical Science, pp. 248-250

Our Environment, How We Use and Control It, p. 359

Understandings and Generalizations

When a substance is heated the energy of the molecules is increased.

Chemical energy can be used to do work.

Compression produces heat; this enables a high compression engine to burn low-grade fuel.

High compression engines are more efficient than gasoline engines.

UNIT VI

ENERGY AND TRANSPORTATION

Content

III. Aircraft

A. Bernoulli's Principle

B. Components of a Force

1. Horizontal Component
2. Vertical Component

C. Lift and Drag Forces in Flight

D. Newton's Third Law

E. Jet Propulsion

1. Simple Jet Engines

IV. Jets, Rockets and Missiles

A. Gas Turbines

1. Turbo-Prop and Turbo-Jet
2. Contrast with Reciprocating Engines

B. Ram Jet

C. Rockets

1. Basic Principles
2. Rocket Motors

D. Missiles

1. Powering
2. Fuels
3. Controls
 - a. Guided Missiles
 - b. Ballistic Missiles

E. Artificial Satellites

Suggested Treatment

Experiment: Show the Bernoulli effect.

Experiment: Show the lift effect of an air stream.

Pupil reports: Lift effect of an air stream on airplane wing.

Discuss force components, using simple examples only.

Discuss, with diagram, the forces acting on an airplane.

Demonstrate Newton's Third Law using a paper or balsa glider.

Examine the control surfaces on a model airplane.

Discussion or report with diagrams: Controlling flight.

Experiment: Show flight due to reaction.

Collect materials from current magazines and newspapers.

Diagram study.

Enrichment: Sound Barrier.

New material in this area is being published constantly; it is wise to start a file for such material early in the year.

Enrichment: This area offers a great deal of scope for reading and exploration.

UNIT VI

ENERGY AND TRANSPORTATION

Aids and References

Basic Physical Science, pp. 252-260

Science, Discovery and Progress, pp. 47-51, 52-53

Our Environment, How We Use and Control It, p. 382

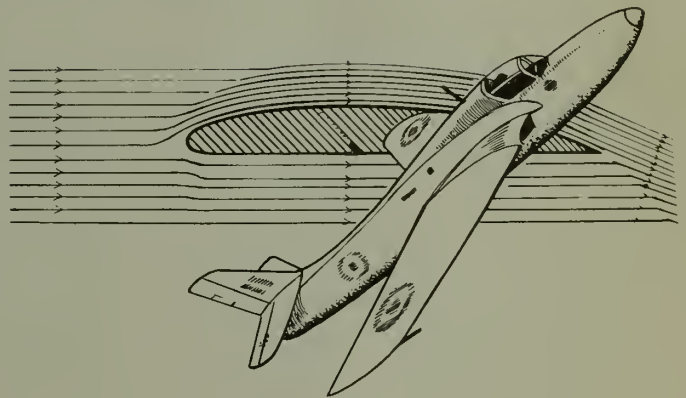
Understandings and Generalizations

Bernoulli's Principle: The pressure within a fluid in motion is lower than the pressure outside the stream; and the greater the speed of the stream the less the pressure within it.

Newton's Third Law: For every action, there is an equal and opposite reaction.

Basic Physical Science, pp. 262-275

Science, Discovery and Progress, pp. 51, 208



As man increases his speed and range of travel many new scientific problems must be met and solved.

**SUMMARY OF EXPERIMENTS AND DEMONSTRATIONS
FOR UNIT VI**

ENERGY AND TRANSPORTATION

1. Show the expansive force of steam.
2. Show how a steam turbine operates.
3. Demonstrate the principle of the carburetor.
4. Show the Bernoulli effect.
5. Show the lift effect of an air stream.
6. Demonstrate Newton's Third Law using a paper or balsa glider.
7. Show flight due to reaction.

Enrichment Reading List

Le Roi, David: *Radar, Radio and Television*, Jet Propulsion and Rocket Power, Clarke, Irwin & Co. Ltd., Toronto.

Grolier Society: *Book of Popular Science*.

Bradley, F. M.: *Solar Energy*, Thomas Crowell Co., New York.

Ahnstrom, D. N.: *Complete Book of Jets and Rockets*, World Publishing, New York.

Thomas, Henry: *Thomas A. Edison*, Putnam & Sons.

De Camp, Sprogne: *Engines*, Golden, New York.

McCormick: *Atoms, Energy and Machines*, Creative Educational Society.

Pratt, Fletcher: *All About Rockets and Jets*, E. M. Hale & Co.

Evans, W. W.: *Petroleum*, Clarke, Irwin & Co. Ltd., Toronto.

Rolt, L. T. C.: *Motor Cars*, Clarke, Irwin & Co. Ltd. Toronto.

Lynch, Patrick: *Man Makes His World*, MacMillan Company of Canada, Ltd.

Braun, Whipple and Ley: *Conquest of the Moon*, MacMillan Company of Canada, Ltd.

Gordon and Scheer: *First Into Outer Space*, MacMillan Company of Canada, Ltd.

Bausch and Lomb Optical Co., Rochester 2, New York:

Milestones in Optical History.

Depth of Focus.

Experiments Using the 3D Microscope.

Filmstrip List and Publishers

How We Get Our Oil, McGraw Hill Co.

Petroleum (P-2766) N.F.B. (National Film Board).

Fires and Fuels (A491-5) S.V.E. (Society for Visual Education, Inc.).

Coal, C. G. (Common Ground).

Gas and How We Get Our Coal, Y.A.F. (Young America Films).

Light and Its Characteristics; The Eye and Optical Appliances; Energy and Engines; The Telescope and Science, Curriculum.

Simple Machines, E.B.F. (Martin Photo Ltd., 350 Donald Street, Winnipeg 2, Manitoba).

Supplementary Filmstrips List

Bernouilli's Principle, Jam Handy.

Visual Sciences—*Light; Heat*, Suffern, New York.

Work and Heat Energy; Transference of Heat, Keystone View Co., Meadville, Pa.

Introduction to Energy, Y.L.P. (Johnson Brothers, 5512-20th N.W., Seattle 7).

Engine Series No. 585-590, Curriculum (Johnson Brothers, 5512-20th N.W., Seattle 7).

Crude Oil Distillation; Hydraulics (T-87), Shell Oil Co.

Our Common Fuels, Coronet.

Molecular Theory of Matter, Encyclopedia Britannica.

Periodicals

1. *Science World Edition I*—bi-weekly throughout the school year
2. *Science World Edition II*—\$2.00 per year. Teachers' Edition \$2.50 per year
3. *Senior Scholastic Magazine*—33 West 42nd Street, New York 36, N.Y.
4. *Science News*—8 times per year, \$1.50 per year. Science Publications of Canada, 25, Hollinger Road, Toronto 16, Ontario
5. *Science News*—Distributed free of charge by The Macmillan Company of Canada Ltd., 70 Bond Street, Toronto 2, Ontario
6. *Classroom Aids for Teachers*—Curriculum Branch, Department of Education, Edmonton, Alberta

List of Apparatus, Equipment and Chemicals for the Grade IX Science Laboratory

- | | | |
|--|---|---|
| 1. Equipment
Test tubes
Beakers
Funnels
Flasks
Glass tubing
Graduates
Thistle funnels
Watch glasses
Calcium chloride tube
Bunsen or alcohol burners
Retort stands
rings
burette clamps
Test tube brushes
Spring balance
Balance and weights
Cork borers (set)
Stoppers
rubber
cork
Test tube racks
Pneumatic trough | Bottles
Filter paper
Litmus paper
Rubber tubing
Iron wire gauze
Mortar and pestle
Crucible tongs
Prisms
Meter sticks
Steel wool
Test tube clamps
Candles
Evaporating dishes
Copper Wire—bare and insulated | Lime water
Kerosene
Gasoline
Baking soda
Vinegar
Alum
Carbon tetrachloride
Lycopodium powder
Alcohol (denatured)
Iodine crystals
Mercury
Potassium permanganate
Strontium chloride
Copper chloride
Coal |
| | 2. Chemicals
Acids— HCl , H_2SO_4 , HNO_3
Sodium chloride
Calcium chloride
Manganese dioxide
Sulfur
Magnesium
Charcoal
Iron filings | 3. Tools
Triangular file
Hammer
Screw driver
Pliers, regular
Pliers, long nosed
6" adjustable wrench |

Special Material for Grade IX

- | | | |
|--|---|--|
| Friction block
Inclined plane board and attachments
Pulleys—single
double
Wheel and axle
Clamp and support for meter stick
Pendulum bob
Mercury barometer tube
Archimedes' Principle apparatus
Model jack screw
Model hydraulic press
Model lift pump
Model force pump
Combustion spoon
Hoffman's apparatus
Condensing bottle
T tube | Milk bottle
Excelsior
Copper tubing (2 feet)
Aluminum tubing (2 feet)
Metal ball and ring
Bimetal strip
A used thermostat
Copper gauze
Composite rod (2' of $\frac{1}{2}$ " diameter
copper tubing and wood
doweling)
Convection current apparatus
Radiometer
Heating coil
Hygrometer
Thermos flask
Carbon sticks | Sandpaper
Asbestos strips
Electric hot plate
Light bulb—200 watt clear glass
Magnifying glass
Fluorescent tube
Small plane mirrors
Flashlight
Lenses—concave and convex
Mirrors—concave and convex
Roll of photographic film
Box camera
Model steam engine
Model gasoline engine
Induction coil
Spark plug
Venturi tubes |
|--|---|--|

DATE DUE SLIP

[illegible]

F255

Q 181-5 A319 1962

ALBERTA DEPT OF EDUCATION
GRADE IX CURRICULUM GUIDE FOR
SCIENCE --

39838123 CURR HIST



000017633033

Q 181.5 A319 1962

Alberta. Dept. of Education.

Grade IX curriculum guide for
science. -

39838123 CURR HIST

CURRICULUM GUIDE

For Reference

NOT TO BE TAKEN FROM THIS ROOM

EXCEPT WITH LIBRARIAN'S PERMISSION

